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A CHEMICAL AND STRUCTURAL STUDY OF MESQUITE, CAROB, AND HONEY LOCUST BEANS.

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PURPOSE OF INVESTIGATION.

Great quantities of mesquite beans are allowed to go to waste each year in the United States. In an effort to promote their utilization the Bureau of Chemistry undertook an investigation to determine whether or not these beans might be made to serve some useful purpose.

The literature was searched for data on the nutritive value of the mesquite fruit. Samples were analyzed in the laboratory to determine the content of sugar and other crude nutrients, and a process for separating the mesquite bean into its component parts was devised. The results of this work, supplemented by notes on carob and honey locust beans, are given in the following pages.

OCCURRENCE.

MESQUITE (*Prosopis juliflora* DC.).

Mesquite, the most common woody plant of the southwestern arid region, has overrun millions of acres in the southwestern part of the United States. Its invasion of grazing lands, especially in Texas, has been so extensive and has occurred so rapidly that it may be compared to the inroads of the boll weevil into the Cotton Belt.

Mesquite grows over a wide range of territory and will flourish where the more valuable carob can not exist. It is common in Hawaii, where it was introduced in 1828 and is known as the algaroba [2] or kiawe bean (*19*) [3], and in Jamaica, where it has been called

[1] The work here reported was conducted under the supervision of G. L. Bidwell, chemist in charge, Cattle Food and Grain Investigation Laboratory. M. R. Coe, C. E. Goodrich, and F. G. Cauffman assisted in the analytical work. C. V. Piper, agrostologist in charge, forage-crop investigations, Bureau of Plant Industry, prepared the statement on the taxonomy of the mesquite and gave several references to the literature.

[2] Shorey (*19*) states that "algeroba" is the usual Hawaiian way of spelling and that this plant is not the true algaroba.

[3] Italic numbers in parentheses throughout this bulletin refer to Literature Cited, page 18.

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"cashaw" (*1*). It is found also from the southern boundary of Utah and Colorado to Chile, and has been introduced into India and South Africa, where it is attracting favorable attention (*5*).

The classification of this plant, according to Holsinger (*15*), is "one of the most perplexful questions." Wooton has classified it as *Prosopis juliflora* and as *P. velutina*, the latter being an arboreal form. Sargent (*18*) holds that forms identified as *glandulosa* (*P. glandulosa* Torr.) and *velutina* are merely varieties of *P. juliflora* DC. According to Piper[4]—

> The mesquites belong to the botanical genus Prosopis, in which there are about 30 valid species, although many more than this have been proposed. One species occurs in Persia and India, one in the eastern Mediterranean region, two in Africa, and the rest in America. Argentina is richest in species, 15 occurring in that country. In one group of species, the pods are coiled and hence called screw-beans. By some botanists these constitute a distinct genus, Strombocarpa. Two species of screw-beans occur in the United States and four in Argentina. The species of Prosopis here considered include *P. juliflora*, described from the West Indies, *P. chilensis* (Molina) Stuntz, originally described from Chile, and *P. glandulosa* and *P. velutina* of the southwestern United States. *P. juliflora* is apparently the same as the older *P. chilensis*, which ranges from Patagonia to Texas. It was also introduced into the Philippines, where it was considered a distinct species and called *P. vidaliana*. *P. glandulosa* is the common mesquite of the Southwest and some botanists consider it a variety of *P. chilensis* (*P. juliflora*). *P. velutina* is a relatively rare plant of the Southwest and by Sargent is considered a pubescent variety of *P. juliflora*. In this paper the three (*chilensis*, *glandulosa*, and *velutina*) are treated as distinct species. The species so abundantly introduced into the Hawaiian Islands is *P. chilensis* and is there known as "kiawe" or "algaroba." This last name is merely the Spanish name of the carob, which has been transferred to somewhat similar leguminous trees, but its use for other than the true carob should be discouraged. In the West Indies the native mesquite is called "cashaw." The common species in the United States (*P. glandulosa* Torr.) occurs from southern California to Texas and Oklahoma. In modern times it has spread greatly and now occupies extensive areas formerly prairie. This is probably due to the seeds being carried by horses and cattle and not being injured in passing through the intestinal tract.

The form of *P. glandulosa* varies greatly, ranging from that of a handsome shade tree, attaining a height of 65 feet in favorable regions near Tucson, Ariz., to a scrubby bushlike growth, usually with an enormous development of the root system. The appearance of the fruit or pods from the southwestern United States varies somewhat with the region in which the beans are grown (Plates I and II). Pods from the Jornada Range Reserve in southwestern New Mexico (Plate I), reported as coming from bushes noticeably different in appearance, were of two distinct varieties. The long slender pods were creamy white, while the others were streaked with dark red or purple which gave them a rusty cast. The appearance of the mesquite beans from Yuma, Ariz., (Pl. II, fig. 2) is not typical because of breakage.

After a favorable season the quantities of mesquite beans available over large areas of southwestern United States are limited only by the facilities for gathering the ripe fruit. Wilson (*25*) states that in southern New Mexico it is not uncommon to see a medium-sized bush, with a spread of not more than 14 to 18 feet, bearing from 1 to 1½ bushels of beans. Although the process of gathering the fruit is tedious, during the 1917 season it could be secured for from 20 to 30 cents per 100 pounds. A native worker at the New Mexico Agricultural Experiment Station gathered about 175 pounds of dried

[4] Unpublished communication from C. V. Piper, May, 1923.

beans in a day (*26*). Since the pods weigh but 21 pounds to the bushel (*8*), however, the man gathered only 8⅓ bushels, not a very strenuous day's work. In a northwestern province of India, a good tree may yield more than 200 pounds of ripe fruit a year (*5*).

In 1917 mesquite beans were gathered and shipped by the carload in Texas (*26*) and in the preceding year mesquite meal to the value of about $225,000 was fed to livestock in Hawaii. Wilcox states that mesquite beans, gathered by women and children in Hawaii, have been sold for from $7.50 to $10 a ton (*24*).

The yield of fruit, of course, varies with the type and size of the tree or bush. It has been stated that 1 acre of land well covered with the trees may produce 100 bushels of fruit per year (*4* and *20*). Two crops a year have been produced in Arizona (*23*) and in Texas, the early crop ripening during the first half of July and the second during the first half of September. Near Yuma, Ariz., the fruit begins to mature early in July. The dry, ripe fruit is said to keep well in storage (*5*).

HONEY LOCUST (*Gleditsia triacanthos* L.).

Like the mesquite, the honey locust is classed as a member of the order Leguminosæ, but it belongs to the family Cæsalpiniaceæ. It grows in western New York and over a large area south from that region. The fruit ripens from the middle to the last part of autumn. The pods and the young trees are relished by livestock. The ripe pods, with their sirupy pulp, are popular with human beings, especially children. Because of the richness of the fruit in sugars and protein, this plant may prove to be of economic value.

CAROB (*Ceratonia siliqua* L.).

The carob, or Saint-John's bread, tree is also a member of the family Cæsalpiniaceæ.

Because of its sensitiveness to frosts, the carob tree is not grown extensively in the United States outside the citrus fruit belts. Condit (*6*) has studied thoroughly the climatic and soil requirements for the successful cultivation of the tree.

The importation of carob beans into the United States through the Atlantic seaboard is of some consequence. Approximately 400 tons of pulverized beans are consumed annually to flavor chewing tobacco, and the ground pods are utilized to some extent as an ingredient of proprietary calf meals, which they are supposed to make more palatable and attractive. Carob pods grown in southern Europe are extensively used for stock feed, and some of the highly esteemed varieties for human consumption.

According to Condit (*6*), the older trees should yield from 450 to 550 pounds of fruit annually. Yields as high as 3,000 pounds a tree have been reported from southern Europe. In southern California the estimated yield per tree from 15 to 30 years old ranges from 20 to 400 pounds.

FEEDING VALUE.

MESQUITE.

A trial feeding of ground dried mesquite fruit to eight grade Duroc-Jersey pigs is reported by Foster (*8*) and by Garcia (*10*) of the New Mexico Agricultural Experiment Station. The production

value of the beans was compared with that of corn over a period of 76 days. During the first four weeks of the trial the ground mesquite beans were only 4 or 5 per cent less efficient than corn. Their efficiency decreased in comparison with corn, however, so that from the end of the fourth week to the end of the experiment, they were only about half as valuable, pound for pound, as corn. When grains were worth $1.50 per 100 pounds, the entire mesquite beans, properly ground and fed to pigs, were worth only 80 cents per 100 pounds. Foster and Garcia state that it has been "estimated" that the entire bean, including the seed, contains the following quantities of digestible nutrients in 100 pounds: Crude protein, 8.34 pounds; carbohydrates, 54.02 pounds; fats, 2.4 pounds. These values compare favorably with those reported for barley.

From an inconclusive feeding trial conducted by the Hawaii Department of Agriculture, Henke (*14*) concluded that the ground fruit possessed merit as a hog feed, but that the ration containing this material was not equal to a standard Corn-Belt ration. The unground pods seemed to be equal in fattening value to the meal, but these results were not considered conclusive.

Few statements that the fruit of the mesquite exerts an injurious effect upon the health of animals eating it appear in the literature. After heartily indorsing the sound beans as food for stock, Abrahams (*1*) issued a vigorous warning against the baneful effects of the "cashaw" fruit after it has been damaged by soaking, with subsequent decomposition. In an appended note it is stated that the pods described as "cashaw" proved to be those of *Prosopis juliflora*. Robertson (*17*) has suggested that the deleterious effect of fermented pods is due to sprouting of the seeds. Goss (*11*) mentions that mesquite and tornillo beans [5] have a constipating effect upon animals.

On the other hand, most writers emphasize the eagerness with which mesquite beans are eaten by stock of all kinds. Griffiths (*12*) states that in southern Arizona "mesquite forms much of the feed during hard times, not only in spring and early summer while it is succulent and green, but also in the winter, when it ordinarily would be considered worthless," and that when pastures along the Santa Cruz were very short not only the pods but the leaves were eaten by cattle. Brown, however, states that browsing animals do not readily eat the foliage of the mesquite (*5*).

In Hawaii as early as 1906, Shorey (*19*) reported that mesquite beans were assuming an important place among local feedingstuffs. Wilcox (*24*) states that "the algaroba, or kiawe (*Prosopis juliflora*), is commonly recognized as the most valuable tree which has thus far been introduced into the Territory of Hawaii." He continues:

> The pods are everywhere recognized as one of the most important grain feeds of the islands and are greatly relished by all kinds of livestock, including chickens. * * * Their (the beans') feeding value has long been recognized from the practical results obtained. As a feeding material there seems to be only one objection to them, and that is a slight flavor given to milk when the beans are fed in excess to the dairy cows. This objection, however, could be overcome by feeding the beans after milking, rather than before milking.

[5] The tornillo, or screw-pod mesquite (*P. pubescens*, Benth.), is closely related to the common mesquite.

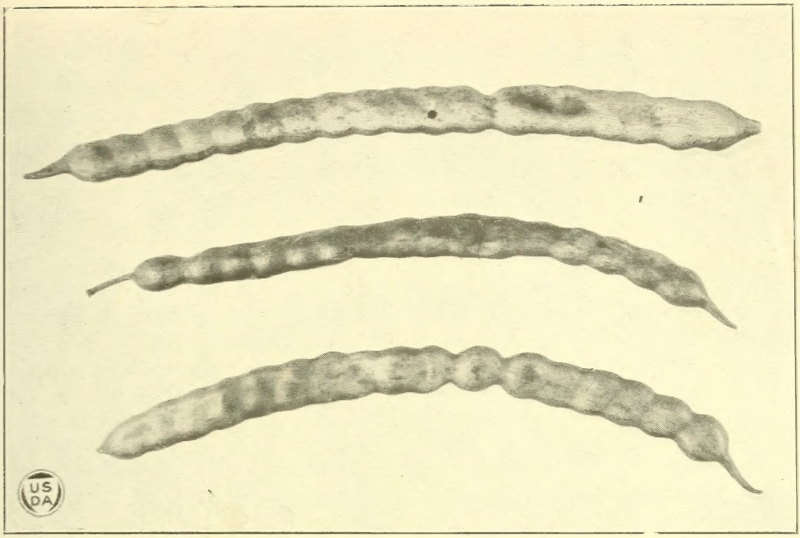

FIG. 1.—MESQUITE BEANS FROM SOUTHWESTERN NEW MEXICO. VARICOLORED FRUIT WITH A HIGH SUGAR CONTENT, HAVING SEEDS OF LIGHT WEIGHT.

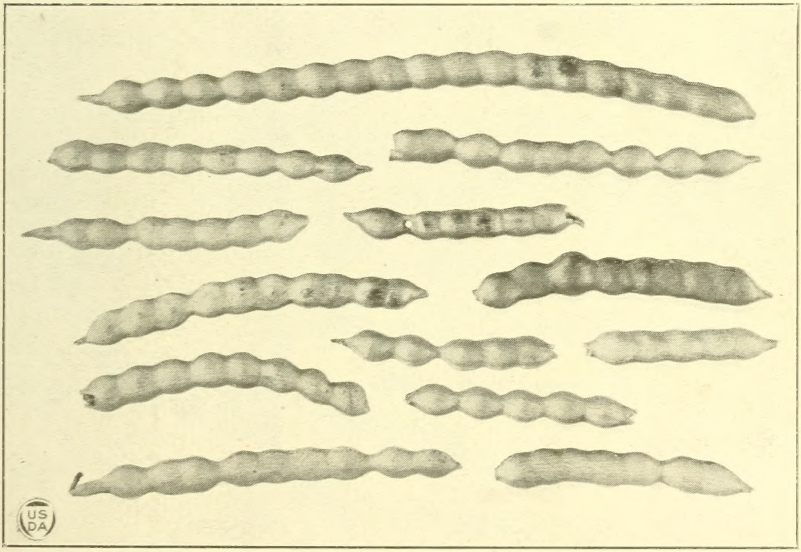

FIG. 2.—MESQUITE BEANS FROM SOUTHWESTERN NEW MEXICO. CREAM-COLORED FRUIT WITH A MEDIUM TO LOW SUGAR CONTENT, HAVING HEAVY SEEDS.

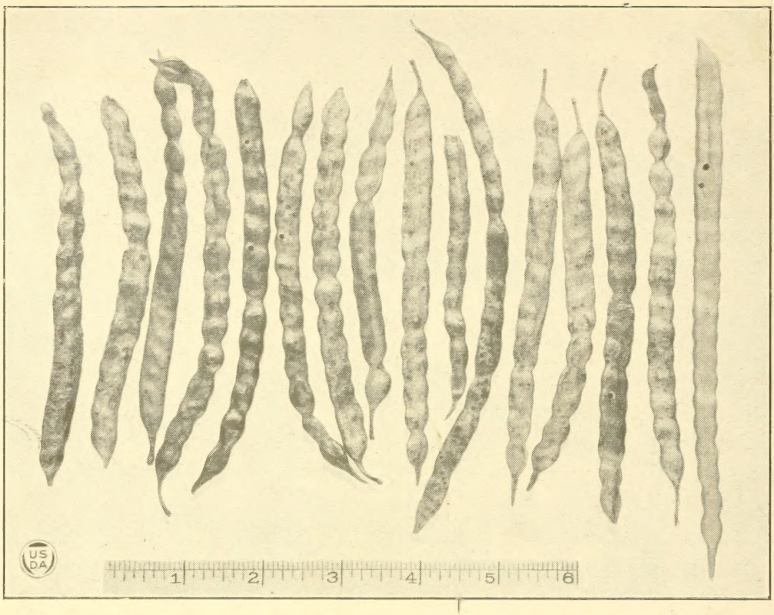

FIG. 1.—MESQUITE BEANS FROM SAN ANTONIO, TEX.

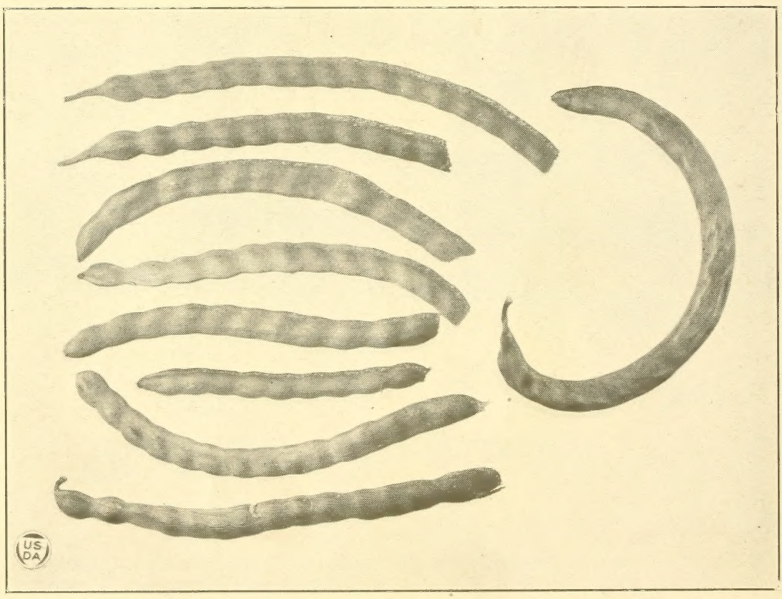

FIG. 2.—MESQUITE BEANS FROM YUMA, ARIZ.

HONEY LOCUST AND CAROB.

No reference to the use of the honey locust as a cattle food, other than a statement that the pods are relished by stock, has been discovered in the literature.

Woll, of the University of California, found that calves relish carob pods greatly and that 0.4 pound of these pods is practically as effective as 0.35 pound of ground barley in increasing body weight (*16*). According to Jaffa and Albro (*16*), carob pods have been used successfully also in feeding steers, for which purpose they should be cooked.

EXPERIMENTAL WORK.

MESQUITE.

The fruit of the mesquite tree consists of at least two types of food material. The pericarp or pod, which includes the epicarp (outer covering), the mesocarp (sugary pulp), and the endocarp (seed husks or seed capsules), contains nearly all of the sugar and most of the crude fiber, tannins, etc. The nutrients in this portion are wholly available to the digestive tract of animals eating the fruit. On the other hand, the seeds, which constitute the rest of the fruit and contain most of the protein and fat, pass practically unchanged through an animal consuming the natural whole fruit. The ease with which the entire seeds pass unchanged through the digestive tract is undoubtedly due largely to their smoothness, extreme hardness, and small size, as well as in part to the relatively indigestible nature of the seed coat. Experiments recently reported by Brown indicate that the viability of seeds is not impaired by their passage through the digestive tracts of sheep (*5*). This property of the protective seed coat of the mesquite bean to resist digestion probably is an important factor in the spreading of the mesquite into new territory.

Undoubtedly much of the nutritive value of the beans is made available by grinding the mature fruit. Such an entire bean meal may serve as an emergency or supplementary forage for stock. There are, however, serious obstacles to the extensive use of the beans in this way. Garcia (*10*) states: "In the (New Mexico) station experiment, it was found difficult to grind them after the pods became thoroughly dried. The large quantity of sugar they contained made them so sticky that they clogged the mill." More important is the tendency of the whole bean meal to ferment and spoil unless it is kept dry. This would militate against its use as a commercial feedingstuff.

Because of the dissimilarity of the two portions of mesquite beans, it is reasonable to assume that the greatest usefulness of each product will be found in treating it as a separate commodity. The problem of its most complete utilization, then, resolves itself into devising means for readily and economically separating the fruit into (*a*) sugary pod and husk material and (*b*) high protein seed meal.

The first experimental work was done in the vicinity of San Antonio, Tex., and data and samples were submitted by the chamber of commerce of that city. An attempt had been made to separate the dried fruit of the mesquite in such a way that material rich in

the sugar of the pods and material with a high content of protein would be secured. The milling process to which the dried fruit was subjected was somewhat similar to the milling received by wheat in making flour.

Table 1 summarizes the analytical data [6] thus obtained.

TABLE 1.—*Composition of dried mesquite fruit separated by experimental milling.*

Sample No.	Material analyzed.	Moisture.	Ash.	Ether extract.	Crude protein.	Crude fiber.	Nitrogen-free extract.	Reducing sugars as invert.	Sucrose.	Galactans.
		P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
29973	Coarse separation, largely seed husks	6.6	3.6	0.9	5.1	42.6	41.2	0.43	7.74	.....
29975	Coarser portion of second separation, containing much seed material	6.7	3.7	2.0	17.1	23.4	47.1	.03	15.30	8.71
29976	Fine separation, high in sugar material	5.8	5.0	2.6	12.8	16.2	57.6	.09	31.66	1.61
29972	Whole fruit, ground	6.9	4.5	1.9	11.6	23.9	51.2	.04	20.69	1.86

The protein and sugar results show that the separations were very imperfect. Batches of ground, dried fruit were prepared later, under the supervision of the San Antonio Chamber of Commerce, especially for the purpose of determining whether or not it would be practicable to gather the fruit when still slightly green or whether it would be necessary to allow it to fully mature on the tree. The composition of material of these two types is given in Table 2. Sample 30178 represents the slightly immature sun-dried fruit, and sample 30179 the fully matured fruit. Except for a somewhat higher sugar content in the fruit picked just before maturity and sun dried, there appears to be no significant difference in composition between the two lots.

An effort was made to prepare sugar (sucrose), or at least an edible sirup, from sample 30179. Neither could be obtained from ground whole fruit by any process which would lend itself to commercial use, owing probably to the presence of the protein of the seeds. By elaborate purification of a water extract of mesquite pod material, crystalline sucrose (cane sugar) was prepared and identified by crystallographic criteria. The method of purification used would not be practicable on a commercial scale. Many years ago Steel (*21*) identified the principal sugar of the mesquite pod as sucrose.

If sugar ever is to be prepared from mesquite, the first step in the process of manufacture must be a fairly clean separation of seed material from pod and husk material. Part of the experimental work of the Arizona station (*7*) therefore was repeated. A representative sample of second crop fruit (sample 32869), composed of mature fruit, but slightly below average in quality because of a wet season (Pl. II, fig. 1), was separated by hand into pod material, husks or seed capsules, seed coats, and seed kernels. The beans had been picked on August 29 and when harvested had a moisture content of over 31 per cent. The composition of this fruit, calculated to the air-dry and moisture-free bases, is shown in Table 2.

[6] The methods of chemical analysis used throughout this work are those of the Association of Official Agricultural Chemists, or such slight modifications of the official methods as are best adapted to material like mesquite beans. The Bryan-Given-Straughn alcohol-extraction method was used in the sugar determinations.

TABLE 2.—*Composition of entire mesquite fruit.*

Sample No.	Material analyzed.	Air-dry basis. Pod portion (entire epicarp).	Seed portion (by difference).	Moisture.	Ash.	Ether extract (crude fat).	Crude protein (N × 6.25).	Crude fiber.	Nitrogen-free extract.	Reducing sugars as invert.	Sucrose.
29972	Mesquite bean meal from fruit of summer crop (San Antonio, Tex.)	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
30178	Mesquite bean meal from sun-dried fruit of fall crop, not fully matured (San Antonio, Tex.)	.....	.....	6.9	4.5	1.9	11.6	23.9	51.2	0.04	20.69
30179	Mesquite bean meal from fully-matured fruit, otherwise like sample 30178	.....	.....	5.6	4.5	2.6	12.2	20.7	54.4	None.	23.77
32869	Whole beans, fully matured, fall crop (San Antonio, Tex.)	.....	.....	5.6	4.6	2.3	13.0	21.9	52.6	0.02	19.11
36452	Whole beans, fully matured (Yuma, Ariz.)	83.4	16.6	10.1	3.5	1.9	11.7	26.8	46.0	1.29	13.83
36453	Whole beans with large fleshy pods (Bard, Calif.)	79.5	20.5	5.5	4.2	1.9	11.9	29.7	46.8	1.68	16.97
36454	Whole beans with pods less fleshy than those of sample 36453 (Bard, Calif.)	88.3	11.7	9.2	4.0	.9	9.5	18.4	58.0	2.43	31.03
	Average (7 samples)	86.0	14.0	13.5	4.0	1.1	9.8	26.9	44.7	.96	17.70
		[1] 84.3	[1] 15.7	8.1	4.2	1.8	11.4	24.0	50.5	.92	20.31

Sample No.	Material analyzed.	Moisture-free basis. Pod portion (entire epicarp).	Seed portion (by difference).	Ash.	Ether extract (crude fat).	Crude protein (N × 6.25).	Crude fiber.	Nitrogen-free extract.	Reducing sugars as invert.	Sucrose.
29972	Mesquite bean meal from fruit of summer crop (San Antonio, Tex.)	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
30178	Mesquite bean meal from sun-dried fruit of fall crop, not fully matured (San Antonio, Tex.)	.....	.....	4.8	2.0	12.5	25.7	55.0	0.04	22.32
30179	Mesquite bean meal from fully-matured fruit; otherwise like sample 30178	.....	.....	4.8	2.8	12.9	21.9	57.6	None.	25.18
32869	Whole beans, fully matured, fall crop (San Antonio, Tex.)	.....	.....	4.9	2.5	13.8	23.1	55.7	0.02	20.24
36452	Whole beans, fully matured (Yuma, Ariz.)	83.0	17.0	3.9	2.1	13.0	29.8	51.2	1.44	15.38
36453	Whole beans with large fleshy pods (Bard, Calif.)	79.9	20.1	4.5	2.0	12.5	31.5	49.5	1.78	17.01
36454	Whole beans with pods less fleshy than those of sample 36453 (Bard, Calif.)	87.8	12.2	4.4	1.0	10.5	20.2	63.9	2.68	34.17
	Average (7 samples)	84.6	15.4	4.6	1.3	11.3	31.1	51.7	1.11	20.46
		[1] 83.8	[1] 16.2	4.6	2.0	12.3	26.2	54.9	1.01	22.09

[1] Average results for four samples. The proportion of pod material increases with the moisture content of the whole sample.

The average weight per whole bean was 3.989 grams when picked, and 3.054 grams when air dry (with a moisture content of 10.1 per cent). This means that the fruit ran approximately 114 beans to the pound when picked and 148 to the pound, air-dry.

Table 3 gives the dimensions of representative whole beans, the number of seeds to the pod, and other data obtained from an examination of 200 specimens of the sound mature fruit. Dimensions were recorded for only a few specimens. The separations into the morphological components were made by hand.

TABLE 3.—*Morphological data on mesquite beans (sample 32869).*

Length.			Breadth.[1]			Thickness.[1]			Number of seeds to pod.[2]		
Min.	Max.	Ave.	Min.	Max.	Ave.	Min.	Max.	Ave.	Min.	Max.	Ave.
Mm. 120	*Mm.* 197	*Mm.* 160.5	*Mm.* 5–8	*Mm.* 9–11	*Mm.* 8–10	*Mm.* 4–5	*Mm.* 5–6	*Mm.* 4½–5½	11	24	18

Air-dry basis (moisture 10.1 per cent).[3]				Moisture-free basis.[3]			
Pods (epicarp, and most of mesocarp).	Seed husks or capsules (endocarp and some mesocarp).	First-grade sound seeds.	Imperfect seeds, etc.	Pods.	Seed husks.	First-grade seeds.	Imperfect seeds, etc.
Per cent. 56.44	*Per cent.* 26.98	*Per cent.* 15.32	*Per cent.* 1.26	*Per cent.* 55.21	*Per cent.* 27.76	*Per cent.* 15.73	*Per cent.* 1.30

[1] Seed-bearing portion.
[2] Sixty-eight per cent of the pods examined contained from 16 to 20 seeds, while 85 per cent of the pods contained from 15 to 21 seeds.
[3] Determinations reported by weight.

TABLE 4.—*Composition of portions of mesquite bean obtained by hand separation.*

Sample No.	Portion analyzed (from sample 32869).	Air-dry basis. Proportion of entire fruit (by weight).[1]	Moisture.	Ash.	Ether extract (crude fat).	Crude protein (N×6.25).	Crude fiber.	Nitrogen-free extract.	Reducing sugars as invert.	Sucrose.	Pentosans.	Undetermined.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
32947	Pod material (epicarp and most of mesocarp)[2]	56.44	12.45	3.29	1.54	6.74	28.11	47.87	3.97	17.56	17.03	[3]9.31
32948	Seed capsules or husks (endocarp and some mesocarp)[2]	26.98	7.89	3.34	.86	4.45	44.14	39.32	2.73	10.95	16.83	[3]8.81
33245a	Seed coats (testæ)[4]	7.33	9.67	2.04	.28	4.50	11.33	72.18	.....	.....	.....	.....
33245b	Seed kernels (embryos)[4]	7.99	6.65	4.93	6.77	[5]65.19	1.91	[6]14.55	.....	.....	.....	.....

Sample No.	Portion analyzed (from sample 32869).	Moisture-free basis. Proportion of entire fruit (by weight).	Ash.	Ether extract (crude fat).	Crude protein (N×6.25).	Crude fiber.	Nitrogen-free extract.	Reducing sugars as invert.	Sucrose.	Pentosans.	Undetermined.
		P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
32947	Pod material (epicarp and most of mesocarp)[2]	55.21	3.76	1.76	7.70	32.10	54.68	4.54	20.06	19.45	[3]10.63
32948	Seed capsules or husks (endocarp and some mesocarp)[2]	27.76	3.63	.93	4.83	47.92	42.69	2.96	11.89	18.27	[3]9.57
33245a	Seed coats (testæ)[4]	7.40	2.26	.31	4.98	12.54	79.91	.....	.....	.....	.....
33245b	Seed kernels (embryos)[4]	8.33	5.28	7.25	69.83	2.05	15.59	.....	.....	.....	.....

[1] The remainder (1.26 per cent) consisted of imperfect seeds and waste.
[2] The mesocarp is the sugary pulp, which on drying adheres to both the outer pod and capsule.
[3] Contained a trace of tannins.
[4] Obtained from first-grade seeds only.
[5] Albuminoid nitrogen, as determined on the kernels by the official (Stutzer) method, constituted 86.26 per cent of the total nitrogen and was equivalent to 56.23 per cent of albuminoid protein.
[6] Starch was entirely absent.

The sound first-grade seeds averaged 0.0346 gram[7] in weight each, or 13,111 seeds to the pound. Forbes (7) states that the small flat seeds are from one-third to one-fourth inch long. The seeds he examined were heavier than those examined in this investigation, approximately 9,600 weighing a pound.

A careful hand separation of over 700 perfect seeds into the seed coats, or integuments, and kernels gave the following results by weight on the air-dry material: Coats (testæ), 47.86 per cent; kernels (embryos), 52.14 per cent.

Table 4 shows the results of chemical analyses of the portions of the mesquite obtained by careful hand separation.

The calculated composition of the two radically different portions of the fruit (the sweet, fragrant portion, composed of the entire pericarp, and the seed portion) is shown in Table 5.

TABLE 5.—*Calculated composition of the two principal portions of mesquite fruit (separated by hand).*[1]

Part of fruit (sample 32869).	Air-dry basis.												
	Proportion of entire fruit (by weight).[2]	Moisture.	Ash.	Ether extract (crude fat).	Crude protein (N × 6.25).	Crude fiber.	Nitrogen-free extract.	Reducing sugars as invert.	Sucrose.	Pentosans.	Tannins.	Undetermined.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Entire pericarp (sugary pod and seed capsule material)	83.42	10.97	3.31	1.32	6.00	33.29	45.11	3.57	15.42	16.97	Trace.	9.15
Entire first-grade seeds (sound and mature)	15.32	8.10	3.55	3.66	36.14	6.42	42.13	.....	.....	.....	.....	.....

Part of fruit (sample 32869).	Moisture-free basis.										
	Proportion of entire fruit (by weight).	Ash.	Ether extract (crude fat).	Crude protein (N × 6.25).	Crude fiber.	Nitrogen-free extract.	Reducing sugars as invert.	Sucrose.	Pentosans.	Tannins.	Undetermined.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct*
Entire pericarp (sugary pod and seed capsule material)	82.97	3.72	1.48	6.74	37.39	50.67	4.01	17.33	19.06	Trace.	10.27
Entire first-grade seeds (sound and mature)	15.73	3.86	3.99	39.32	6.98	45.85	.....	.....	.....	.....	.....

[1] The figures are calculated from the results in Table 4.
[2] The rest (1.26 per cent) consisted of imperfect seeds and waste.

Efforts were next made to attain by the use of machinery the same sharp separation of the seed. The following machines were used: A small hand coffee mill; a small grain and bean cleaner, modeled after machines common in the industry and fitted with a blower fan, as well as with screens; and a large mortar and pestle. All these were hand operated.

A new subdivision of the air-dry material from sample 32869 was thoroughly dried in a vacuum oven at 65° C. It seemed necessary to do the work on dry days, as the sugary portion of the pods absorbs

[7] This is the average weight for more than 2,700 seeds.

moisture from humid air very quickly. The dried beans were coarsely broken in the coffee mill in such a way as not to rupture the seed capsules, and the resulting material was shaken in a 3-millimeter sieve, through which only pod and sugary material passed. The material remaining on the sieve, consisting of the seed capsules, was further ground in the coffee mill, with the burrs set about 4 millimeters apart. This grinding rubbed off most of the sugary pulp material but broke few of the seed capsules, if any. After a second sieving on the 3-millimeter sieve the seed capsules were quite clean. The sugary material passing through the sieve was, of course, combined with the pod material. The burrs of the coffee mill were now set a little closer (from 2.4 to 3.2 millimeters apart), and the seed capsules were ground slowly through the mill. After putting the material through twice and sifting the smaller seeds through the 3-millimeter sieve, the material remaining on the sieve contained the broken capsules or husks and most of the whole seeds.

The small seeds passing through the 3-millimeter sieve, for the most part imperfect, are identified as second-grade seeds. The seeds and broken husks remaining on the 3-millimeter sieve were separated in the model grain and bean cleaner, and behaved much like threshed grain. The cleaner was so adjusted that the material passing through a screen having 4.8-millimeter circular holes was subjected to the action of the blower fan which completed the separation of seed from husks. Thus by the process described an excellent separation of the original dried beans into pod material, husk material, and seeds was secured.

Next the first-grade seeds were milled by means of the mortar and pestle. They were first "tempered" by having about 5 per cent of their weight of water added and being allowed to stand overnight in a closed vessel in cold storage. This softened and made somewhat elastic the seed coats, without affecting the kernel material. The low temperature inhibited fermentation. The tempered seeds were broken in the coffee mill, care being taken not to break the seed coats any more than could be helped. The broken seeds were rubbed in the mortar, using sufficient pressure on the pestle to grind the kernel material to a meal. The more elastic integuments were not broken to any great extent. The action of the coffee mill and mortar and pestle on the tempered seeds resembles that of the several breaks in a flour mill on tempered wheat. The well rubbed material was sifted through a 20-mesh sieve, and the seed coats remaining on it were returned to the mortar for further rubbing. Eventually a large part of the seed coats was rubbed free or practically free from kernel material. The material passing through the 20-mesh sieve, which contained all of the kernels and a small quantity of disintegrated seed coats, was further rubbed and sifted through a 40-mesh sieve. This "reduction" process, similar to that employed in a flour mill, was continued until only two main products and a small quantity of material containing a little of the seed coats, designated "shorts," were finally obtained. So little of this "shorts" material was obtained that it was combined with the kernel material.

The relative quantities of the several portions of the mesquite bean obtained by this mechanical separation and their chemical composition are shown in Table 6

TABLE 6.—*Composition of portions of mesquite beans obtained by mechanical separation.*

Sample No.	Portion separated (from sample 32869).	Partially dry basis. Proportion of entire fruit (by weight.)[1]	Moisture.	Ash.	Ether extract (crude fat).	Crude protein (N×6.25).	Crude fiber.	Nitrogen-free extract.	Reducing sugars as invert.	Sucrose.	Pentosans.	Undetermined.
		P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
33423	Pod and sugary material	60.5	2.82	3.96	2.21	9.81	29.19	52.01	3.47	19.93	.....	28.61
33424	Seed capsules or husks	25.1	3.10	3.33	.58	4.21	52.65	36.13	1.73	7.55	.....	26.85
32949	Seed coats[2]	3.8	9.14	2.06	.59	7.00	10.94	70.27	.05	.07	14.54	[3]34.95
32950	Seed kernels[2]	3.6	6.06	4.86	7.29	61.22	2.63	17.94	None.	3.79	5.65	8.50

Sample No.	Portion separated (from sample 32869).	Moisture-free basis. Proportion of entire fruit (by weight).[4]	Ash.	Ether extract (crude fat).	Crude protein (N×6.25).	Crude fiber.	Nitrogen-free extract.	Reducing sugars as invert.	Sucrose.	Pentosans.	Undetermined.
		P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
33423	Pod and sugary material	60.8	4.07	2.27	10.10	30.04	53.52	3.57	20.51	.....	29.44
33424	Seed capsules or husks	25.2	3.44	.60	4.34	54.33	37.29	1.79	7.79	.....	27.71
32949	Seed coats[2]	3.6	2.27	.65	7.70	12.04	77.34	.06	.08	16.00	[5]38.46
32950	Seed kernels[2]	3.5	5.17	7.76	65.17	2.80	19.10	None.	4.03	6.02	9.05

[1] The rest (7 per cent) includes the following: Imperfect or second-grade seeds, 2.3 per cent; miscellaneous mixture (offal), 3.4 per cent; and intangible loss, 1.3 per cent. The seeds and "offal" were not analyzed.
[2] Obtained from first-grade seeds only.
[3] Contained 20.66 per cent of galactans.
[4] To obtain these results it was necessary to assume moisture figures for the second-grade seeds and "offal." These seeds were assumed to have the same moisture content as the first-grade seeds.
[5] Contained 22.74 per cent of galactans.

A comparison of the results in Table 6 with those in Table 4, particularly the figures for protein on the moisture-free materials, indicates that in the mechanical separation some seed material must have remained with the pods and that the milled seed coats contained a small quantity of the high-protein embryo substance. Both the protein and crude-fiber results suggest that an appreciable quantity of the seed-coat material is mixed with the kernels. Nevertheless, by this experimental milling, a means has been outlined for a reasonably sharp mechanical separation of the fruit of the mesquite. It has been demonstrated, on a laboratory scale at least, that, provided the fruit is kept "bone-dry," it is practicable to obtain by milling the entire pod material, containing over 94 per cent of the sugar originally present in the whole fruit, and the whole seeds. The seeds, after being moistened or tempered, may be milled, thus securing seed kernels in the form of meal or flour containing from 17.5 to more than 40 per cent of the total protein of the fruit, and seed coats, a sort of "bran" by-product.

The seed-coat material contains over 14 per cent of pentosans, 20 per cent of galactans, and nearly 35 per cent of other readily hydrolyzable carbohydrates. The absence of starch makes these undetermined carbohydrates of interest as a possible source of uncommon sugars.

Containing over 60 per cent of crude protein, the embryo portion, or kernel meal, is one of the richest natural protein concentrates in the vegetable kingdom, slightly surpassing the oil-free kernels of cotton seed and peanuts.

The reporting of the satisfactory results obtained in this laboratory experiment should not be construed as a proof of the commercial feasibility of the process. The fruit used had been very thoroughly dried at low heat and the first stage of the milling was conducted in a dry atmosphere. However, in the arid Southwest and for many months in the semiarid regions, the atmospheric conditions are ideal for such drying and milling.

Table 7 gives the results of the analyses of the four samples of beans [8] that were separated into seeds and pods. In order to determine the true composition of the entire fruit of material like mesquite beans it is necessary to first divide the sample into two portions, such as pods (high in sugar) and seeds (high in protein), and analyze the portions separately, because of the difficulty in weighing out a representative charge from a ground sample of the whole beans. The averages of all available results for the composition of pods and seeds are given in Table 7.

TABLE 7.—*Average composition of pericarp and seed of mesquite beans.*

Sample No.	Partially dry basis.		Moisture-free basis.							
	Moisture.	Proportion of entire fruit (by weight).	Ash.	Ether extract (crude fat).	Crude protein (N×6.25).	Crude fiber.	Nitrogen-free extract.	Reducing sugars as invert.	Sucrose.	Pentosans.
Entire pericarp (sugary pod and seed capsule portion):	*Per ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
32869	10.97	83.42	3.72	1.48	6.74	37.39	50.67	4.01	17.33	19.06
36452	5.08	79.52	4.73	1.14	7.17	37.43	49.53	2.15	20.45	.....
36453	1.87	87.41	4.39	.67	6.94	22.05	65.95	3.05	38.60	.....
36454	3.95	84.44	4.68	.93	7.09	35.37	51.93	1.31	23.74	.....
Arizona (3) [1]	5.64	73.10	5.33	1.49	6.21	32.49	54.48	.....	.....	.....
Hawaiian (2) [2]	17.82	.....	3.54	.17	6.78	25.99	63.52	.....	.....	.....
Average (9 samples)	8.27	[3] 79.16	4.51	1.00	6.68	31.30	56.51	.....	.....	.....
Entire seeds:										
32869	[4] 5.73	[4] 16.58	3.68	4.13	35.79	7.53	48.87	0.03	2.01	11.12
36452	7.11	20.48	3.48	5.56	33.85	7.85	49.26	.32	3.39	.....
36453	5.66	12.59	4.40	3.04	35.65	7.59	49.32	None.	2.32	.....
36454	4.98	15.56	4.26	3.25	34.73	7.96	49.80	None.	2.43	.....
Arizona (3) [1]	7.81	26.90	3.49	6.09	37.33	6.60	46.49	.....	.....	.....
Hawaiian (2) [2]	14.31	.....	5.16	4.92	37.23	8.53	44.16	.....	.....	.....
Average (9 samples)	8.39	[3] 20.84	4.07	4.90	36.27	7.53	47.23	.....	.....	.....

[1] Reported by Forbes (*7*) (3 samples).
[2] Average figures reported by Shorey (*19*), with slight corrections for nitrogen-free extract (2 samples).
[3] Average for 7 samples only.
[4] Calculated, assuming that all material not pericarp consists of seed. The results differ somewhat from those for the seed material actually recovered.

In connection with the San Antonio experiments (p. 6), an attempt was made to separate by mechanical means the previously dried and ground fruit, or mesquite bean meal, into portions representative of the pods, husks, and seeds. The best that could be accom-

[8] Samples 32869, 36452, 36453, and 36454 represent beans from Texas, Arizona, and California, the composition of the entire fruit of which is reported in Table 2.

plished by sieving and the use of a blast of dry air (a winnowing process), which produced an effect not unlike that of suction fans or aspirators in a grain mill, was unsatisfactory. The results of this experiment, the proportionate weights of the several separations, and their chemical composition are reported in Table 8.

TABLE 8.—*Chemical composition of separations from mesquite bean meal.*

Sample No.	Portion separated from sample 30179.	Proportion of original bean meal represented (by weight).	Composition.							
			Moisture.	Ash.	Ether extract (crude fat).	Crude protein (N×6.25).	Crude fiber.	Nitrogen-free extract.	Reducing sugars as invert.	Sucrose.
		P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
33311	On 3 mm. sieve; largely husks	17.6	2.3	5.5	0.4	3.1	51.8	36.9	1.0	6.9
33312	Sugary concretions; on 3 mm. and on 20-mesh sieve;[1] heavy	2.1	3.1	5.1	1.4	6.9	17.5	66.0	2.2	35.5
33313	Broken seeds, husks, etc., on 10-mesh sieve[2]	2.0	.....	.....	.....	.....	.....	.....	.....	.....
33314	Broken seeds, sugary concretions, etc., through 10- on 20-mesh sieve	13.0	7.4	3.7	2.3	17.4	12.4	56.8	None.	16.3
33315	Broken husks, chaff, seed coats, etc., through 20- on 40-mesh sieve; light	4.2	5.1	3.9	1.4	9.1	23.8	56.7	.....	.....
33316	Broken seed kernels, coats, etc., through 20- on 40-mesh sieve; heavy	15.9	5.6	4.2	3.0	23.1	15.3	48.8	Trace.	18.8
33317	Broken husks, kernels, etc., through 40- on 60-mesh sieve	7.0	4.6	4.0	1.2	11.1	26.4	52.7	1	21.0
33318	Like sample 33317, but through 60- on 80-mesh sieve	17.3	4.8	4.1	1.4	9.6	24.9	55.2	1.1	21.2
33319	Like sample 33318, but with more sugar, through 80- on 100-mesh sieve	5.1	4.1	4.5	1.8	10.0	19.9	59.7	1.2	24.8
33320	Through 100-mesh sieve; largely sugary mesocarp	12.5	4.1	5.3	2.2	12.8	12.1	63.5	1.0	33.3
.....	Miscellaneous material and intangible loss[3]	3.3	.....	.....	.....	.....	.....	.....	.....	.....

[1] The numbers of the sieves refer to the number of meshes to the inch; the mesh is square.
[2] Not analyzed.
[3] Insignificant miscellaneous material, not analyzed.

Although the preparation of commercial sugar[9] for table sirup is not properly within the scope of this investigation, the analysis of the residue after subjecting the sugar-bearing material of the mesquite bean to water extraction (by diffusion) is pertinent. Samples of pod, husk, and ground whole fruit were treated with boiling water, by diffusion, in such a way as to extract most of the soluble substances. The undissolved residues were dried, ground, and analyzed; and the nitrogen content, sugar content, and acidity of the water extracts were determined.

Table 9 shows the quantity and composition of moisture-free undissolved residue, the quantity of moisture-free solids extracted, and the percentages of protein and sugars and the degree of acidity in the extracted solids, as calculated from the results of the determinations made on the water extract.

[9] Beet-sugar houses are often glad to obtain other material on which to work after the close of the 4-month beet-sugar season. Many turn their attention to the manufacture of sorghum sirup. If an abundant supply of mesquite pod material were available, it is possible that such factories could be operated on the manufacture of sugar or sirup from the pods, provided the problem of defecating and purifying an extract of this material were solved.

TABLE 9.—*Chemical composition of undissolved residues and extracts from hot-water extraction of mesquite bean products (moisture-free basis).*

Product extracted by hot water.	Material analyzed.	Proportion of original product extracted (by weight).[1]	Composition.							
			Ash.	Ether extract (crude fat).	Crude protein (N×6.25).[2]	Crude fiber.	Nitrogen-free extract.	Reducing sugars as invert.[2]	Sucrose.	Degree of acidity.[2]
		P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Cc. N. acid per kilo.*
Mesquite beans (sample 32869).	Undissolved residue (sample 33764).	73.5	2.3	2.2	14.6	46.0	34.9	.....	.....	.....
	Solids extracted (sample 33763).	19.6	.....	.....	10.5	.....	.....	10.0	53.1	1,046
Pods, epicarp, and mesocarp, separated by hand (sample 32947).	Undissolved residue (sample 33766).	58.2	1.5	2.6	7.1	51.5	37.3	.5	.2	.....
	Solids extracted (sample 33765).	40.0	.....	.....	7.0	.....	.....	9.6	53.1	727
Pod material from mechanical separation (sample 33423).	Undissolved residue (sample 33770).	59.7	1.7	2.5	8.6	51.1	36.1	.5	None.	.....
	Solids extracted (sample 33769).	37.5	.....	.....	9.4	.....	.....	7.6	47.5	805
Seed capsules or husks, endocarp, separated by hand (sample 32948).	Undissolved residue (sample 33768).	72.5	2.1	.8	3.6	61.0	29.5	.....	.....	.....
	Solids extracted (sample 33767).	25.5	.....	.....	7.6	.....	.....	10.4	49.5	845
Seed capsules from mechanical separation (sample 33424).	Undissolved residue (sample 33772).	78.1	2.2	.6	4.0	63.2	30.0	.4	.3	.....
	Solids extracted (sample 33771).	18.8	.....	.....	9.4	.....	.....	9.5	42.3	957
Broken seed capsules from mesquite bean meal (sample 33311).	Undissolved residue (sample 33776).	83.2	5.0	.4	2.8	60.1	31.7	.5	.....	.....
	Solids extracted (sample 33775).	14.6	.....	.....	5.5	.....	.....	5.1	52.9	740
Mesquite bean meal (sample 30178).	Undissolved residue (sample 33774).	70.0	3.9	2.5	14.1	33.1	46.4	.....	.....	.....
	Solids extracted (sample 33773).	24.4	.....	.....	8.1	.....	.....	.1	56.6	619
Thoroughly extracted mesquite bean meal (sample 30178).	Insoluble residue (sample 30609.)	.....	2.7	3.4	17.5	41.1	35.3	.....	.....	.....

[1] The sum of "undissolved residue" plus "solids extracted" is equal to the moisture-free substance in the original product extracted.

[2] The figures representing the content of protein, sugars, and acidity in the "solids extracted" were obtained from results of actual determinations made on the water extracts, by calculating to a moisture-free basis.

Table 10 gives the results of analysis, both those determined in the present investigation and those reported in the literature, for whole mesquite beans.

TABLE 10.—*Average composition of mesquite beans.*

Samples from—	Air-dry basis.					
	Moisture.	Ash.	Ether extract (crude fat).	Crude protein (N × 6.25).	Crude fiber.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Hawaii (5 samples)	12.3	3.3	0.6	9.0	23.4	51.4
Arizona (4 samples)	6.3	4.5	2.5	[1] 12.7	24.5	49.5
California (2 samples)	11.4	4.0	1.0	9.7	22.6	51.3
New Mexico (1 sample)[2]	4.8	3.4	2.5	12.2	32.0	45.1
Texas (7 samples)[3]	6.9	4.4	2.7	12.4	25.7	47.9
Southwestern United States (14 samples) Min.	4.8					
Southwestern United States (14 samples) Max.	13.5					
Southwestern United States (14 samples) Average	7.2	4.3	2.4	12.1	25.4	48.6
New Mexico (Tornillo beans)	5.1	3.0	1.0	9.8	19.3	61.8

Samples from—	Moisture-free basis.				
	Ash.	Ether extract (crude fat).	Crude protein (N × 6.25).	Crude fiber.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Hawaii (5 samples)	3.7	0.7	10.2	26.8	58.6
Arizona (4 samples)	4.8	2.7	[1] 13.5	26.2	52.8
California (2 samples)	4.5	1.2	10.9	25.6	57.8
New Mexico (1 sample)[2]	3.6	2.6	12.8	33.6	47.4
Texas (7 samples)[3]	4.8	2.9	13.3	27.6	51.4
Southwestern United States (14 samples) Min.	3.6	1.0	10.5	20.2	39.5
Southwestern United States (14 samples) Max.	5.5	5.4	15.1	34.6	63.9
Southwestern United States (14 samples) Average	4.6	2.5	13.0	27.4	52.5
New Mexico (Tornillo beans)	3.2	1.1	10.3	20.3	65.1

[1] Albuminoid nitrogen constituted 80.8 per cent of the total nitrogen (average of 3 determinations (7)).
[2] The fuel value of this sample is reported to be 1765 calories per pound (3).
[3] One of these samples represented pods picked green and dried, and another represented windfalls (3).

HONEY LOCUST.

A sample of the sound ripe fruit from a honey locust tree in the United States Department of Agriculture grounds in Washington, D. C., was separated into pericarp and seeds, and the two portions were analyzed. Their composition and that of the whole fruit is given in Table 11.

TABLE 11.—*Composition of honey locust and carob.*

Sample No.	Material.	Air-dry basis. Proportion of entire fruit (by weight).	Moisture.	Ash.	Ether extract (crude fat).	Crude protein (N × 6.25).	Crude fiber.	Nitrogen-free extract.	Reducing sugars as invert.	Sucrose.
	Honey locust:[1]	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
28662	Pods (entire pericarp)	67.2	3.6	3.9	0.6	7.1	19.3	[2]65.5	2.2	23.1
28663	Seeds	32.8	5.1	3.2	2.6	26.3	10.1	52.7	.....	.....
28662, 28663	Entire fruit	100.0	4.1	3.7	1.2	13.4	16.3	61.3	.....	.....
	Carob:									
9381	Pods (entire pericarp)[3]	.....	8.4	2.4	.2	3.8	5.9	79.3	.....	.....
10050	Do	.....	7.4	.....	.4	5.3	6.1	.....	12.5	26.6
Average of 17 samples.	Do.[4]	89.0	11.5	2.7	2.4	4.5	8.8	70.1	11.2	23.2
10050	Seeds	.....	9.6	.....	1.5	15.9	6.4	.....	None.	2.6
Average of 6 samples.	Do[4]	11.0	11.7	3.2	2.5	16.5	7.5	58.6	.....	.....
34137	Entire fruit[5]	100.0	11.3	2.9	.3	5.1	6.0	74.4	.....	.....
34138	Do.[6]	100.0	8.3	3.1	.3	4.3	7.9	76.1	.....	.....
34139	Do.[7]	100.0	9.6	3.2	.3	4.2	7.9	74.8	.....	.....
Average of 8 samples.	Do.[4]	100.0	13.3	2.6	2.2	6.8	9.3	65.8	11.1	19.4

Sample No.	Material.	Moisture-free basis. Ash.	Ether extract (crude fat).	Crude protein (N × 6.25).	Crude fiber.	Nitrogen-free extract.	Reducing sugars as invert.	Sucrose.
	Honey locust:[1]	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
28662	Pods (entire pericarp).	4.0	0.6	7.4	20.0	[8]68.0	2.3	24.0
28663	Seeds	3.4	2.7	27.7	10.7	55.5	.....	.....
28662, 28663	Entire fruit	3.9	1.2	14.0	17.0	63.9	.....	.....
	Carob:							
9381	Pods (entire pericarp).[3]	2.6	.2	4.2	6.4	86.6	.....	.....
10050	Do	.....	.4	5.7	6.6	.....	13.5	28.7
Average of 17 samples.	Do.[4]	3.1	2.7	5.1	9.9	79.2	12.7	26.2
10050	Seeds	.....	1.7	17.6	7.1	.....	None.	2.9
Average of 6 samples.	Do[4]	3.6	2.8	18.7	8.5	66.4	.....	.....
34137	Entire fruit[5]	3.3	.3	5.7	6.8	83.9	.....	.....
34138	Do.[6]	3.4	.3	4.7	8.6	83.0	.....	.....
34139	Do.[7]	3.5	.3	4.7	8.7	82.8	.....	.....
Average of 8 samples.	Do.[4]	3.0	2.5	7.9	10.7	75.9	12.8	22.4

[1] Gathered from trees (*Gleditsia triacanthos* L.) growing in Washington, D. C.
[2] Contained 10.9 per cent of pentosans.
[3] Identified as pods of *Ceratonia siliqua*.
[4] Average of results reported by Jaffa and Albro (*16*) on California carob.
[5] Italian carob.
[6] Portuguese carob.
[7] Cyprus carob.
[8] Contained 11.3 per cent of pentosans.

A comparison of the composition of portions of the honey locust with that of corresponding parts of the mesquite bean shows that, while the locust pods have a slightly lower total sugar content, the entire fruit of the honey locust is materially lower in crude fiber and probably averages somewhat higher in crude protein.

CAROB.

Table 11 gives the results obtained by Jaffa and Albro (*16*) on the composition of the pods, seeds, and whole fruit of the carob, as well as the results on imported Italian, Portuguese, and Cyprus carob beans analyzed in the Bureau of Chemistry.

Jaffa and Albro reported the presence of 1 per cent of starch in carob pods, but none in the seeds. Only traces of tannin were found in the pods. While the carob pods, on an average, are much higher in total sugar and a great deal lower in crude fiber than the honey locust, the whole beans are deficient in crude protein. In fact, the whole fruit of the carob contains only from one-third to one-half as much crude protein as either the honey locust or the mesquite.

SUMMARY.

Mesquite beans, which grow over large areas in the southwestern part of the United States, in the West Indies, in Hawaii, in South Africa, and in India, should have some economic value.

Meal made from the entire bean may serve as an emergency or supplementary food for stock. Authorities in general agree that the fruit of the mesquite is a valuable feedingstuff when sound, but that it may be harmful to stock if it has been subjected to soaking. A more complete utilization may be made of the beans if they are separated into two distinct products—the sugar-bearing pericarp and the protein-bearing seeds. Such a separation can be effected only when the material is kept perfectly dry during the entire process.

Sucrose was prepared from the pods of the mesquite which are rich in nonreducing sugar. The seed kernels were exceptionally rich in protein and the seed coats contained an unusually high proportion of pentosans, galactans, and other carbohydrates.

The seeds of the honey locust contain less protein than the mesquite seeds, but the whole fruit contains more protein and less crude fiber than the whole mesquite beans.

The carob, another closely related plant, growing in the citrus-fruit belts of the United States, is also used in the manufacture of stock foods. Carob pods contain more sugar and much less crude fiber than honey locust pods. The whole fruit, however, contains only from one-third to one-half as much crude protein as either the honey locust or the mesquite.

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